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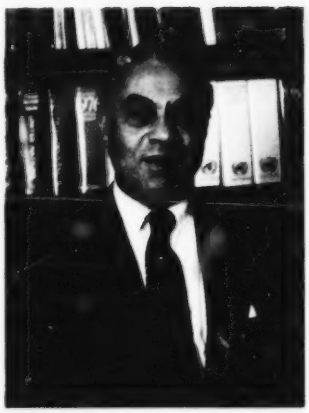
SPECIAL REPORT:
Ways with Waste

Planning for the Future from Lessons Learned in the Past

By G. Arthur Brown



G. Arthur Brown

Looking back at the International Drinking Water Supply and Sanitation Decade (IDWSSD), we are all disappointed that the primary goal of providing safe drinking water for all by 1990 was not achieved. Over one billion people remain without access to good quality potable water while nearly two billion people have no sanitary means of disposing of human waste.

We started 1991 with this huge deficit. And when we speak of what we can achieve by the year 2000, we must remember the devil which defeated us in the decade that just passed—population growth.

In the first half of the 1980s, the population in developing countries increased at an average rate of 2.1 per cent per year compared to 0.6 per cent per annum in developed countries. In Africa alone, the 3 per cent rate of population growth was higher than in any other region for the period 1980-1985. During the 1980s, the inhabitants of developing countries swelled by over 700 million. And as long as population continues to grow at the same rate, we are going to be running fast just to stand still.

In fact, by the year 2000, of the 22 metropolises with more than 10 million people, 18 will be in the developing countries of Asia and the Pacific, Africa and Latin America.

Given the scarcity of water, and in order to feed the world's growing population and improve living standards, existing supplies of water have to be utilized and managed more efficiently.

We must, therefore, direct our attention toward institution building and training. But we must recognize that capacity building is of long lineage. When we speak of sustainability, human resources development or self-reliance, we are expressing the same hopes and ideas, namely that in developing countries we will have institutions and people who can manage water resources appropriately. How can we ensure that sufficiently high quality water is available to satisfy the needs of people and other competing uses such as irrigation, hydropower, transportation and even recreation? A balance must be struck.

Planners of water and sanitation have to make sure that this God-given resource is exploited and made available to people in a sustainable way. The word *sustainability* has become a buzz word among environmentalists but it does not mean that it is not an appropriate objective. If whatever we do offers a solution for only a short period of time, then we have failed. It is our duty to ensure that generations to come will be provided with adequate supplies of water.

I have listened to many speeches

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G. Arthur Brown is Governor of Jamaica's Central Bank and the Chairman of the Steering Committee for Cooperative Action for the International Drinking Water Supply and Sanitation Decade. He was a former Associate Administrator of UNDP.

source

December 1991

Page 16: Recycling bottles in Manila.

Page 22: Duckweed farming requires intensive labour.

Cover: A Shanghai sanitation worker. Photo by Emma Robson / UNDP.

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Director:
J. Russell Boner

Managing Editor:
Emma Robson

Senior Editor:
I. Rajeswary

Design:
Esther Kurti, Director
Nieves Singian, Assistant
Maureen Lynch

Editorial Assistants:
Mila Feliciano
Jennifer Prince

Translations Manager:
Elizabeth Scott Andrews

Production:
Linda Inocencio-Groux
Annie Straw
Afsaneh Djabbari
Danielle Strahl

Circulation:
Alison Walton
Dorothy Toy

Distribution:
Welde Hailemelekot
Aubrey Trotman

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Ways with Waste

United Nations, New York—Management of wastes—animal, human, domestic and industrial—is one of many formidable challenges facing governments today. How to dispose of refuse economically and without endangering the environment is a problem shared by developed and developing countries alike.

But while more affluent cities can contemplate investing in modern, less polluting incinerators to destroy waste surpluses, poverty severely limits the range of options open to cities in the developing world. In many developing country cities, disposal of solid wastes created by households and industries consumes up to half of the municipal budgets. Many have yet to install their first sewage and wastewater treatment plants.

One solution available to both North and South is to reduce the volume of wastes created. Several modern industrial cities are offering incentives to industries to encourage them to reduce packaging. They are also passing more rigid legislation regarding treatment of waste effluents.

Many cities now require households to separate different categories of solid wastes—newspapers, plastics, glass and metal—for recycling. As the article on waste management in Manila suggests, such a strategy could work even better in developing countries, where poverty has given rise to long established markets for recycled products.

The article on recycling in Shanghai shows how over 40 years of resource recovery by the Chinese government has created dozens of profitable recycling companies, many of which have invented inspired uses for the seemingly useless.

Even human and animal excrement has value. Waste stabilization ponds that purify sewage may entail investments that are only partially recovered. But as guarantors of human health, their value is inestimable. Besides, some of the land and human labour costs can be offset by raising fish, or worms for fishfeed as described in the Malaysia article on managing pig effluents.

The Ecuador article on waste disposal discusses the health and environmental benefits from the proposed construction of a new and modern landfill outside Quito.

The technology article proposes that duckweed, which feeds on and purifies wastewater, could vastly improve sanitary conditions in rural areas, while amassing high profits and providing employment and better nutrition.

Clearly, there are many ways of dealing with wastes safely and even profitably. But first, governments and planners need to decide that they want to tackle the problem and be committed to the task.—Emma Robson

Scouring a waste dump outside Manila for recyclable goods.

China's Centuries-old Recycling

By Emma Robson

Shanghai, China—For centuries, the Chinese have excelled in recycling waste, finding lucrative and inspired uses for the seemingly useless, like human hair, animal bones and even urine.

Take bone china. Dynasties ago, Chinese craftsmen found that ground animal bone adds a fine, translucent quality to clay artifacts. The discovery has enriched the tea-drinking experience of the affluent from the days of Marco Polo on and gave birth to a thriving porcelain industry in Europe. It also led to a Chinese tradition of recycling animal bones.

Today recycling reverberates throughout Chinese life, from construction to defecation. In urban areas rubble is compacted into bricks or used for landfill. In rural areas farmers continue the ancient practice of applying human and animal solid wastes and organic refuse as manure and compost to their fields. Waste recovery is an activity involving myriads of recycling companies and individuals. As a result of over 40 years of waste recovery promotion by the Chinese government, they reuse more than 10 million tonnes of inorganic wastes each year.

In 1949, when the People's Republic of China came into being, recycling was adopted as a key instrument for promoting economic growth, protecting the environment and conserving natural resources. A special unit set up within the Ministry of Commerce encouraged the effort by giving tax breaks to companies that recycle wastes or use recycled products.

This led to the discovery of some surprising uses for waste products, like urine. In the 1970s, the Chinese determined that the amino acids found in urine could be profitably extracted to supply the pharmaceutical industry. Urban architects were dispatched to their drawing boards to design a collection system for human urine which was adopted in many public urinals in China's cities.

In Shanghai, the urine is funnelled into tanks that are emptied daily by the Shanghai Bureau of Environmental Sanitation (SBES). According to Ye Chuan Ze, deputy chief of the SBES,

Ye Chuan Ze is deputy chief of Shanghai's Bureau of Environmental Sanitation.

the Bureau collects 200 tonnes of urine per day which it sells for just under US$3 a tonne to pharmaceutical companies in the Shanghai area. Among the Bureau's major customers is the Shanghai Biochemical and Pharmaceutical Laboratory, which according to director Han Chao-Lin, transforms urine into products worth $10.4 million a year, yielding profits of $1.5 million. Its best sellers are blood anti-coagulants used widely in surgery, which it exports mainly to Europe, Japan and the US.

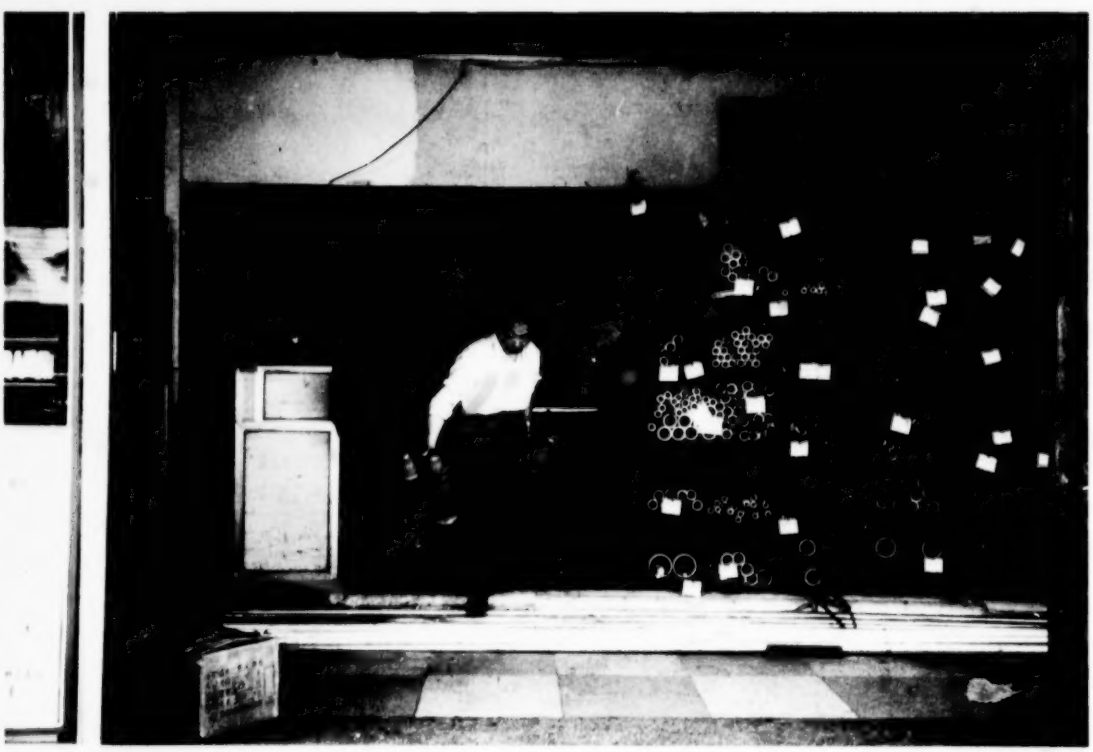
The largest and most diverse company in the waste business in China is the Shanghai Resource Recovery and Utilization Company (SRRUC). Its prime raw material is garbage created by Shanghai's 13.5 million people and nearly 100,000 registered companies. It even imports waste material, including scrap paper from the US which it turns into egg cartons, cardboard boxes and toilet paper.

After paying 62 per cent of its earnings to the central government, the company turns in a net profit of about $19 million each year and provides employment for nearly 25,000 people. It also prevents waste from piling up on the city's rubbish tips. "Making money and protection of the environment are our main guiding principles," says SRRUC General Manager Wu Hong Cheng.

Since its establishment in 1957, SRRUC has reclaimed nearly 40 million tonnes of waste, which it processed and sold for about $2.5 billion at current exchange rates. In 1990, the company recycled an average of 4,300 tonnes a day, nearly 50 per cent more than the 3,000 tonnes dumped daily in garbage tips by the Sanitation Bureau.

To collect such a large volume of waste, the company has set up a massive network of purchasing and processing centres throughout the municipality, an area covering 340 square kilometres. Individuals sell their wastes by the kilo to more than 500 purchasing stations scattered throughout the area. The intake of these shops is supplemented by more than 1,500 agents who scout the narrowest alleys and remotest villages for scrap. But over 80 per cent of the

Tradition Gears for the Future



A hardware store managed by SRRUC.

wastes are purchased by SRRUC from industrial and commercial enterprises.

Among the most important types of waste materials recycled by SRRUC are iron and steel. The company's ferrous metal smelter employs 900 people to process 65,000 tonnes of scrap iron and steel a year. It makes manhole covers and counterbalances for lifts and bridges, much of which it exports to Japan, and wood and iron garden benches and tables, which it exports mainly to the US. For the domestic market, it makes drainage pipes, tools and other hardware, which are sold in shops managed by the company.

Its most profitable area is the extraction of precious metals from photographic materials. "We get gold and silver from used film and rhodium from watches," says Chen Qiuying, an electrical engineer who handles the SRRUC's foreign trade relations.

The company's rubber factory collects all the used rubber slippers and tyres of the Shanghai area and imports 15,000 tonnes of tyres a year, mainly from Japan, Taiwan and the Philippines. The best tyres are cleaned, stripped of their cloth interior and repaired for sale in China at about one-half the cost of new tyres.

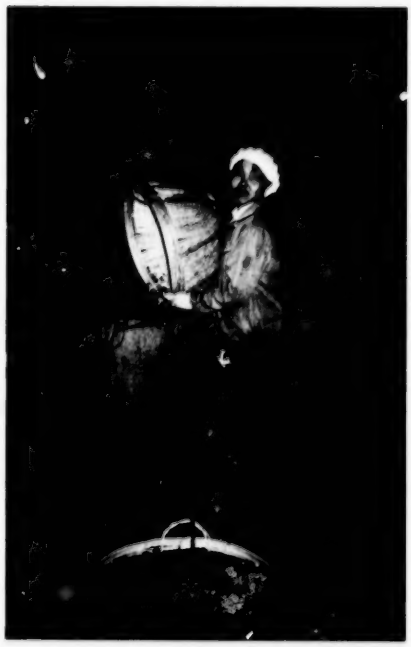
The inferior rubber is transformed into blocks in a simple but efficient process patented by the company which uses chemicals, heat and pressure. The company has shown great skill in identifying a number of uses for lower grade recycled rubber such as treads of bicycle pedals, shoe soles and gaskets. The factory also produces higher quality raw materials by adding new rubber to the regenerated product for greater elasticity. Such grades are used, for example, to make white surgical gloves, which have found a major market in the US.

Ironically, in trying to clean up the environment, SRRUC itself causes pollution. "By their very nature, wastes create secondary wastes in the recycling process," notes Mr. Chen. The increasing amounts of secondary pollution created by several of SRRUC's plants are forcing the company to make some hard decisions.

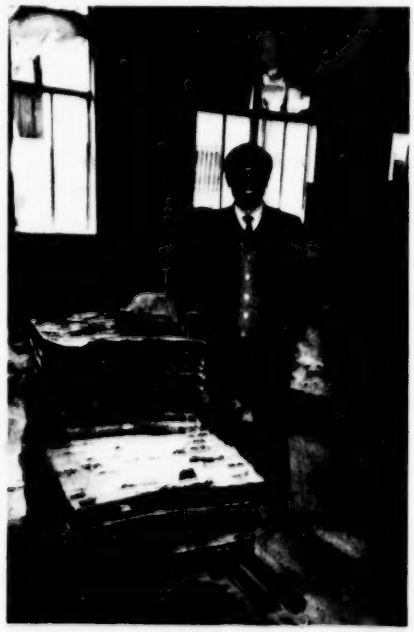
Already, SRRUC has been forced to abandon a process that used hair cuttings to extract amino acids to make hair restoring lotions. "We had to close the factory in 1987," says Mr. Chen.

"The effluent it discharged was too polluted and the factory gave off a nasty odour that fouled the air of the surrounding neighbourhood."

For similar reasons, in 1988, the Shanghai Xingguang Plastics Factory, an SRRUC affiliate, suspended Perspex recycling. The main end products were fashion buttons. "Besides the fact that we were creating unacceptably high levels of air pollution, suddenly



Left to right: Low-grade rubber wastes are transformed into regenerated rubber sheets in a simple, economical process.



resin buttons became more fashionable than Perspex ones," says Director Tang Jian Hui. The company has also stopped--perhaps temporarily—its bone recycling business. "It created pollution, and demand from England, our main market, fell," says Mr. Chen.

The company each year pays the Shanghai Administrative Bureau of Environmental Protection charges based on how much untreated waste it discharges. In recent years, the Bureau has raised those charges sharply to finance expansion of its environmental control activities. "It gets to the point where we either have to make a big investment to install the necessary emissions controls, or close some operations," says Mr. Chen.

The SRRUC hopes to prevent future closures by improving production efficiency while reducing the amount of pollution it creates. To this end, with financing from the Belgian government through the United Nations Industrial Development Organization (UNIDO), the plastics factory has installed modern equipment to produce its main

The SRRUC's iron and steel smelter transforms scrap metal into products ranging from counterbalances to garden chairs (left).

Photos by Jemma Robson / UNDP

product, granulated polyethylene. Mr. Tang says efforts will be made to transfer this more efficient technology to 200 assembly lines throughout China.

The precious metals business has also been earmarked for refinement. "We're introducing with help from UNIDO a cleaner technology to recover platinum," says Mr. Chen.

The ferrous metals smelter, meanwhile, has invested $950,000 in a new, locally designed blast furnace whose better heat conductivity will cut coal consumption by 20 per cent. The current furnace burns 30,000 tonnes of coal a year to process up to 100 tonnes of pig iron a day. "There is a lot of pressure on us to clean up our operations," says Director Wu Agen. "So we are also designing a bag to filter fumes and we're selling ash to be used to make cement."

Mr. Wu, SRRUC"s general manager, sees the introduction of greater production efficiency as the key to reconciling the company's profit making and environmental mandates. "There are so many products that are profitable, like our iron business," he says. "Those lines can subsidize the non-profitable areas." The company loses $7.50 per tonne of broken glass it collects, most of which is sent for processing to South Korea. "Broken glass is harmful to society, so it is best to recycle it, even if we lose a little."

Unless it can cut down on factory emissions, the company will find it difficult to increase the volume of wastes it recycles. This in turn will place a greater strain on the sanitation bureau, which is responsible for disposing of all uncollected domestic and factory waste. "At the city's current rate of waste production, our present disposal site will fill up in 15 years," says Mr. Ye of the SBES. "We have been assigned another dump to use, but we hope to put off using that new space for as long as possible."

Just how the sanitation bureau will do that is not yet clear, says Mr. Ye. Incinerators are not considered an option on account of their high cost and the air pollution they create. A recent experiment to compact the bulkiest refuse—demolition rubble—into bricks foundered because of a market preference for smaller bricks made of local clay. "We just could not make money on bricks," says Mr. Ye. The SBES collects more than 3,000 tonnes of demolition rubble daily from building sites for a fee. If he can find the money, Mr. Ye says he plans to make a second attempt at developing a more marketable brick. In the meantime, the rubble is mounting in outlying fields and in the dump.

Plans to increase the city's use of organic refuse are also stalling through lack of funds. Nearly three-quarters of the domestic refuse collected by SBES is organic matter that could be reused. Currently, the SBES composts a small portion that is sold to farmers as a soil conditioner. "We would like to use more of the excess organic waste to create energy through biogas," says Mr. Ye.

By far the biggest responsibility of the SBES is to safely dispose of human waste. It is a herculean task given the city's size and the fact that only 13 per cent of the population has traditional waterborne sewage facilities. About one-quarter use buckets they empty into receptacles in their yards, and the rest have toilets that empty into septic tanks. The SBES's efforts to recycle human wastes profitably are admirable, and are expected to continue as part of a more comprehensive sanitation solution for the entire population.

The SBES collects nearly 90 per cent of Shanghai's human waste. But partly for lack of sufficient waste treatment plants, 20 per cent of that is dumped untreated into rivers. The vacuum trucks of the SBES remove more than 8,000 tonnes of night soil and seepage

The plastics factory recently introduced more sophisticated European technology to improve productivity.

each day from public toilets, septic tanks and night soil dumping stations. During the night, the wastes are shipped by river and canal in sealed barges to depots on the outskirts of the city. There the waste is stored for between 10 and 30 days in covered tanks, after which it is sold to farmers whose experience has shown it to be safe to apply to fields as manure.

While the Shanghai recycling experience is by no means perfect, it offers useful lessons to countries both in the developing and developed world. Every year about 500,000 tonnes of polyethylene sheets are discarded in the Chinese countryside, and only half are recycled. "The rest suffocate the soil because they do not dissolve," says Mr. Tang of the plastics factory. "Yet there is a lack of raw materials for making plastics in China, so it's profitable to recycle." Mr. Tang believes that even more industrialized countries, where labour costs are high, should be able to get an economic return from recycling plastics. "You eliminate a source of environmental pollution, make use of a waste, and produce a recycled material that costs less than a similar new material," he says. It costs the factory $190 to recycle one tonne of polyethylene, which it then sells for up to five times more, which is still only 50 or 60 per cent the cost of similar new products. "In Europe, where you have much more efficient equipment, I cannot see how it would not be profitable," says the engineer.

Fang Cheng Xian, general manager of the rubber factory, believes the company's recycled rubber production line would be a major asset in North America. "The US makes no effort to reuse its tyres," says Mr. Fang. "That's a waste and bad for the environment." US tyres, unlike those made in Asia, have steel reinforcements that make them awkward to recycle. Still, Mr. Fang reckons it would be less expensive to recycle them using the company's production line than to discard them. Many US states charge environmental fees for disposal of tyres. New York charges garages $1 for each tyre it discards. "We pay to get used tyres and still make a nice profit," says Mr. Fang.

While specific technologies and practices could be beneficial to industrialized countries, one engineer who has studied the SRRUC in depth believes that the system has more to offer middle income developing countries with large populations. "The after-tax earnings of the SRRUC could cover the entire payroll of the SBES, which has 30,000 employees," says Charles Gunnerson, who advised SRRUC and SBES in the mid-1980s as senior project officer under a global resource recovery project of the United Nations Development Programme (UNDP) and the World Bank. "It requires a massive, low-cost labour force and only the most basic Western technology," says Mr. Gunnerson, who teaches water resources engineering and waste management at the University of California in the US. "It's a system that could upgrade the present recycling operations in cities like Jakarta, Bangkok, and many others throughout the developing world."

Mr. Gunnerson recommended that the SRRUC offer consultancy services to other developing countries for a fee. So far, Mr. Wu says it has not acted on that proposal, although it has had some useful exchanges with a Hungarian recycling company. "Other developing countries perhaps can learn from us," says Mr. Wu, "but we have so much to learn ourselves. Right now we want to upgrade our products, improve our technology, and introduce some of the best equipment from the industrial countries." ■

Sanitation workers pre-sort domestic waste in preparation for the evening shipment upstream.

Malaysia's Pig Farmers

By I. Rajeswary

Petaling Jaya, Malaysia—Until recently, pig breeders in Malaysia swilled their animals' pens twice daily with scant regard for the environment or their neighbours. Short of moving, those living nearby had little choice but to endure the smelly animals, the putrid odour of their feces, the stench of wastewater in their drains and of pig faeces that clogged irrigation canals, drainage ditches and village creeks.

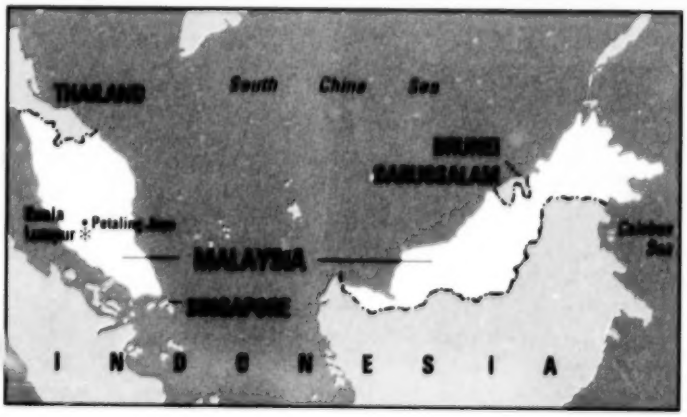
Another problem was that pig farmers are predominantly of Chinese descent and many of their neighbours were Muslims who regard pork as unclean.

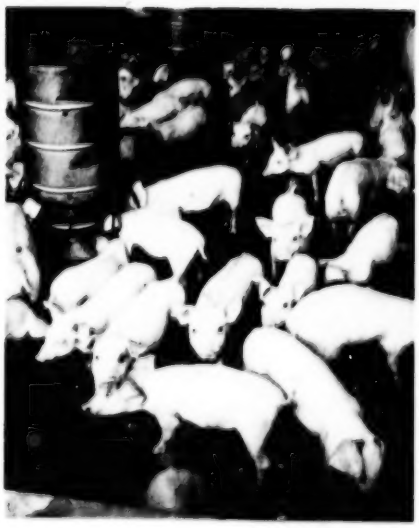
As pig production swelled and farms expanded, an increasingly vociferous anti-pig lobby arose. These protesters urged that the industry be properly regulated, that the environmental pollution caused by traditional methods of raising pigs be monitored, and that pig breeders carry out their profession far away from human activity.

The government was anxious to solve this problem in the interest of its multi-ethnic, multi-religious population. Islam, the official religion of Malaysia, is practised by over 50 per cent of the population. The rest are Buddhists, Hindus and Christians. To ban pig farming as Singapore had done was not an option, for pork is eaten by nearly 40 per cent of Malaysia's total population of over 17 million. Pig production is growing at a rate of seven per cent a year and accounts for nearly one-third of the livestock industry. Moreover, Singapore's ban on pig farming—a practical environmental solution given the island's dense population—has brought increasing business for Malaysia's pig exporters. This year, Malaysia exported nearly a million live pigs—40 per cent of its production—to its southern neighbour.

The federal government therefore decided to introduce regulations governing pig farming. In 1983, it decreed that the raising of pigs be confined to designated areas in each of the country's 13 states, that the animal waste be treated, and that land and rivers surrounding the farms be kept clean to check environmental pollution and protect public health. It further mandated that future development of the pig industry should respect social and religious sensitivities.

But as urban areas encroached on





Piglets are kept in separate pens in a farm in Selangor.

S. Yogendran / IPS Selangor, Malaysia

traditional farming areas, it soon became clear that laws alone were not sufficient to control pollution from pig waste. What was needed was better planning and a waste management technology that could be adopted easily by farmers.

To this end, the Department of Veterinary Services (DVS) for the State of Selangor, which has a large pig population, approached the United Nations Development Programme (UNDP) for assistance in waste management and in preparing a comprehensive plan for the future development of pig farming throughout the country. UNDP, together with the Food and Agriculture Organization of the UN (FAO) happened to be conducting similar research in Singapore.

In 1985, a US$1.2 million project financed by the government, UNDP and Canada and executed by FAO was launched in Malaysia. Selangor served as the test state for pilot efforts in developing integrated waste management. The Agricultural University of Malaysia and the Malaysian Agricultural Research and Development Institute were also involved. They were joined by Singapore's Pig and Poultry Research and Training Institute in the spirit of technical cooperation among developing countries.

Selangor's DVS had been studying the problems of pig farming since 1975 in relation to Singapore's commercial pig industry. The island republic was then trying to manage pig waste and control pollution. At that time, pig farming in Malaysia was still a backyard activity. When Singapore banned pig farming, DVS continued with its research and identified one promising solution: waste treatment ponds.

The idea would be to treat pig effluent by holding it in ponds until biodegradation occurs as a result of two groups of bacteria found in the waste. The first group liquefies and breaks down the large molecule compounds into small molecule compounds. The second group ferments the acids into methane. Afterwards the stabilized solids are pumped out for use as manure. DVS researchers calculated the technology would reduce environmental pollution by 80 per cent.

Raymond Choo, veterinary officer of Selangor DVS, recalls that project

Clean Up Their Act

A worker removes sludge from the lagoon for use as compost.

I. Rajeswary / UNDP

officials were conscious of not just finding appropriate technology for waste management but also ensuring that the measures adopted were suitable for tropical climates. Daily temperatures in Malaysia average over 30° C. "We also had to make sure that the technology chosen was viable for the industry," says Mr. Choo.

Waste sampling and treatment technologies were experimented on four sites—two in Selangor and two in the state of Negri Sembilan, which also has a high concentration of pigs.

The "solids stabilization treatment technology" eventually agreed upon involves digging five-metre-deep lagoons, the number and size depending on the number of animals on the farm. Pig wastewater and discharge from the pens is channelled into the ponds where the fecal matter is broken down. Depending on the size of the lagoons, the liquids and solids are held in the lagoons from 30 days to 12 months, after which the stabilized solids are pumped onto sludge drying beds for use as compost.

The technology was a success. "This method is simple and easily adaptable," says Mr. Choo, "and it reduces pollution by 80 per cent." It does have some drawbacks. It is only economical for farms with at least 3,000 pigs. It requires additional land and it creates an unpleasant odour.

Yet for Yeong Sing Kiow and many larger farm managers like him, it is a suitable technology. At his 10-hectare farm in Bukit Pelandok in Negri Sembilan, a two-hour drive south of Petaling Jaya, he applies the "solids stabilization treatment technology" to treat the wastes of his 40,000 pigs. He has allocated eight hectares for waste treatment as recommended by DVS. Biodegradation takes place in three huge lagoons 240 metres long, 45 metres wide and five metres deep. Workers remove the sludge once every

Pig waste and discharge are channelled to lagoons where they biodegrade over time.

Photos by I Rajeswary / UNDP

A pig farm in Selangor, the State with the largest number of pigs.

six to 12 months.

Some farmers have turned to making money from pig waste. The introduction of a special red earthworm culture *lumbricus rubellus* into the lagoons produces thin, reddish tubifex worms. The worms feed on the solids in the ponds and multiply. The farmers then pack these tiny worms in small cans and sell them as fish feed for $0.75 each to aquarium shops in Singapore.

Presently, pig farms in Malaysia are still scattered all over the country. Some are near residential areas or in the vicinity of Muslim villages. It was only in April this year—eight years after the government mandated designated pig farming areas in every state—that Selangor, Negri Sembilan and Johore enacted legislation to regulate the industry.

But already, improvements launched in Selangor are pleasing both Muslims and non-Muslims living in the vicinity of pig farms. Pigs are no longer slaughtered on farms but at abattoirs located away from the city and residential areas. The animals, which used to be transported in rattan baskets on the back of open lorries, are now ferried in covered but ventilated metal crates.

Selangor has also identified seven sites for permanent pig farming. Other states are following. Perak and Malacca have earmarked land pending the approval of similar legislation. When the regulations are enforced nationwide, says Mr. Choo, small farms will be phased out or be forced to merge with others to make pig rearing a profitable livelihood. Once permanent pig farming zones are established, says Mr. Choo, the department may explore the possibility of centralized waste treatment. ■

Manila, Philippines—Flanking the Marala River to the west and Manila harbour to the south, the towering waste heap of Smokey Mountain stands as a symbol of the growing garbage problems of the developing world's burgeoning cities.

It is also a powerful expression of urban poverty. This 20-hectare site receives much of the 3,500 tonnes of domestic wastes created daily by the city's nine million people. But it is also home to 500 families and a main source of income to a further 2,500.

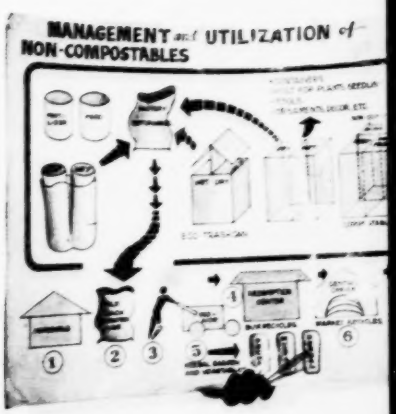
Shortly after midnight, when the first of the city's 400 rubbish trucks drop their daily load, these scavengers, many of them children, start combing the dump for anything they can sell.

Scaling Dow

By Emma Robson

Curt Carnemark

Paper from garbage dumps is sold to waste dealers.



Dr. Metodio Palaypay has devised a wastes recycling plan for Metro Manila.

n Manila's Waste Mountains

Some specialize in tin cans, others in plastics. Others collect only organic matter to make compost. For hours they crawl among rats, mice, flies, cockroaches and reams of refuse with lamps attached to their foreheads, like miners digging for gold. At daybreak they sell their pickings to waste dealers for an average of US$2 to $5—enough to get by until evening.

Their plight has been well publicized in the domestic and international media, which has helped keep the city authorities and dozens of environmentalists busy devising solution proposals. One official proposition, that the dump be razed and its inhabitants relocated, was vehemently rejected by the scavenger community. "None of these people want to live on Smokey Mountain," says Dr. Metodio Palaypay, who teaches public health at the University of the Philippines in Quezon City, "but they feel forced to stay there because they see it as the only means of making money."

At best, the residents of the area around the dump site live without running water or sanitation in shacks with galvanized iron roofs. Nearly all suffer from one ailment or another. Dr. Palaypay has identified more than 35 different diseases that stem from living near rubbish tips. "At waste dumps you get higher densities of mosquitoes, rats, cockroaches and flies. As a result you can get malaria and other parasitic diseases, skin diseases, and in Manila, even bubonic plague." Studies have found many of the mice that inhabit Smokey Mountain are hosts to the flea that carries the *Black Death*. "Just think how vulnerable we are as a city to germ warfare," says Dr. Palaypay. Many of the scavengers who work barefoot risk also getting infected from the syringes and other hospital waste that is present on the dump. "Hepatitis B is a very common problem," says Dr. Palaypay.

Emma Robson / UNDP

But there are ways in which scavengers can make money from wastes without endangering their health. One is to organize workers into teams that collect separated solid wastes from households before it gets to the dumps. A local non-governmental organization, the Metro Manila Council of Women Balikatan Movement, has been trying such an approach for the past eight years under a programme called *Linis Ganda*, the words for "clean" and "pretty" in *Tagalog*.

In 1983, it began collecting dry wastes from residents of San Juan, a largely middle class town within Metro Manila. Before operations began, the Council sent out leaflets explaining that if households put their dry wastes into separate containers reserved for glass, plastics, papers and tins, collectors would visit once a week and pay them a small fee depending on the volume and quality of their garbage. More than 12,000 families in San Juan agreed to cooperate with the scheme, which has since been expanded to cover three other districts, serving a total of about 20,000 households.

To date, the organization has enrolled more than 100 collectors, or "eco-aides," in the programme. These individuals, usually unemployed or underemployed young men, are each given a painted pushcart and T-shirt emblazoned with the words *Linis Ganda* and assigned a collection route. The workers are directly supervised by the owners of three large junk shops, who give them $3.70 a day in seed money to purchase the wastes. At the end of a collection round, the workers return to the junk shop, where they are paid according to the going market price for their wastes. "They often get double what they paid families for it," says Leonarda Camacho, founder of the Balikatan Movement. Under an agreement struck with the organization, the junk shop owners also provide food, drink and basic living facilities for the collectors and their families on the junk yard premises.

Former construction worker Jimmie Montes, 37, makes between $18.50 and $36 a week working as an eco-aide at the junk shop of Armando Tarnate in San Juan, where he lives with his wife and three children. "The money is not any better than before," says Mr. Montes. "But this job offers free accommodation, and that's a big help." Mr.

Tarnate was already a junk shop owner in 1983 when Ms. Camacho approached him with her waste collection plan. At the time he bought scrap at the yard but operated no collection network. He says the new arrangement has helped boost turnover. He now receives more than $250 a week from waste recycling factories that buy from his warehouse. Such earnings have allowed him to buy a *jeepney* and move into a pleasant four-bedroom house with a marble floor and three servants.

Ms. Camacho says the scheme has won favour also with the city's main recycling operations, for it provides them with a more reliable and larger source of bulk wastes. Ms. Camacho personally established contact with steel and paper mills and rubber and plastics factories which process the waste. These factories set the purchase prices according to market conditions and keep the junk shop owners posted of changes. The San Miguel Corporation, the national brewery, takes all the glass bottles and broken glass accumulated by the junk shops, as well as used bottle tops, which the company previously did not recycle. Rubberworld, a major manufacturer of rubber products, takes all used rubber slippers collected by the programme, which is another item that was not traditionally recycled. The junk shops export much of the used cardboard they collect to Taiwan and Japan, where they can get a higher price.

The idea of launching a garbage recycling operation came to Ms. Camacho in the mid-1970s while on a trip to Switzerland. "In Switzerland, I noticed that paper was collected on certain days, bottles on other days," says Ms. Camacho. "So I decided to adapt that idea to Manila by paying households a small fee as an incentive to separate their garbage." Ms. Camacho believes that the fact households are paid to separate their wastes is a major attraction of her operation. Households disposing of high quality wastes receive about $1 a week, while those with poorer pickings make only $0.20. The payment is modest, but in addition the collection service is helping reduce the monthly bills families pay the sanitation company for removal of domestic refuse. Organic wastes like food and vegetable peelings make up 30 per cent of average household refuse and are still collected by the authorities for a fee.

Manila, unlike many European and US cities, has no law requiring households to separate their wastes at source. "In the past, it was hardly necessary," says Dr. Palaypay, "cashing in on refuse has always been a means of survival for the poor." Dr. Palaypay, who describes himself as a "garbologist," has spent years investigating uses of wastes and recycling practices. He estimates that in Manila, most used bottles and clean cardboard, 80 per cent of newspapers and plastics, one-fifth of tin cans, broken glass and small bottles, are recycled without the existence of penalties or incentives set by government.

But the city's recent growth has given rise to a waste problem that informal solutions alone will not resolve. Since 1975, Metro Manila's population has been expanding at more than three per cent a year. The presence of the newcomers is straining the city's capacity to provide social services. As a result, an estimated 30 per cent of dry wastes created daily go uncollected.

"One-quarter of Metro Manila is densely squatted," says Dr. Palaypay. "It's virtually impossible for vehicles to reach those areas. Many of the makeshift houses erected by the squatters back on to the city's network of canals, which once served as an effective natural drainage system for rainwater. The inhabitants throw their refuse into the canals. "So the garbage mounts up and the canals become clogged," says Dr.

Balikatan Movement Inc

Sorting out bottles for recycling.

Emma Rebour / UNDP

Linis Ganda workers remove floating waste in canals.

Palaypay. Metro Manila already has serious drainage and flooding problems. The polluted Pasig River frequently overflows, causing damage to properties in an area spanning nearly 5,000 hectares.

The *Linis Ganda* programme is helping in a small way to reduce canal garbage pollution. In addition to collecting from households, some of the eco-aides ply the waterways in small boats bought by the Balikatan Movement and remove all floating waste. "We have only 10 boats and therefore cannot possibly keep all the waterways clear," says Ms. Camacho, "but we are the only organization collecting wastes from the canals."

While the *Linis Ganda* scheme has demonstrated a viable approach to reducing urban wastes and creating jobs, Ms. Camacho is quick to point out obstacles currently preventing the model from being applied on a larger scale. One of the barriers is lack of funds. "The programme is not self-financing," she says. "It is funded by private contributions and run by 40 women who work voluntarily." But in her view, by far the biggest obstacle to organizing recycling on a large scale is an absence of legislation. "Government should pass an ordinance requiring households to separate their wastes and ready them for collection on different days," she says. Dr. Palaypay agrees: "You need government legislation, such as tax rebates for non-pollution, to encourage businesses to recycle more products."

After the passage of legislation, Dr. Palaypay proposes offering scavengers at Smokey Mountain jobs as official city waste collectors working in tandem with the junk shop owners throughout the metropolitan area. "I would give them a cart, a shovel, and a pig," he says. They would raise the pig as extra income, feeding it on organic wastes. Only 10 per cent of the organic wastes created by the city are currently reused as compost, Dr. Palaypay says. To use up the surplus, he suggests establishing a composting pit and biogas plant in each community, to be managed by the eco-aides themselves. The sale of dry wastes would be handled through redemption centres that would pool the wastes of clusters of neighbourhoods to create economies of scale. "Any surplus dry wastes could be used by young people to make useful recycled objects they can sell," says Dr. Palaypay.

Such a solution would require a lot of organization and funds. But it would surely be better than opening a new landfill site, which is one alternative currently being proposed by city officials to handle Manila's growing waste burden. Besides creating another Smokey Mountain situation, environmentalists say the dump site proposed for Cavite in the Manila Bay area would pollute the sea and endanger the city's water supply, much of which is drawn from a watershed next to the proposed site.

The promotion of waste recycling would also cool debate on another controversial issue: whether or not to introduce incinerators. The city built one incinerator at a cost of nearly $2 million which, because of pressure from environmentalists, never began operations. By the time it was completed, the surrounding area had become so densely populated that to run it would have posed too great a health hazard. Some waste management experts advocate small-scale incinerators to dispose safely of hospital wastes. But given the strength of local opposition, it is unlikely incineration will win out over recycling in the quest for a broader approach to scaling down Manila's waste mountains. ■

SPECIAL REPORT

New Waste Dump for Quito

By Sid Kane

Quito, Ecuador — A cleaner, healthier environment is a goal close to the hearts of municipal leaders throughout Latin America, especially with the UN Conference on Environment and Development (UNCED) set to take place in Rio de Janeiro in June.

For many of the region's urban centres, the challenge of finding environmentally sound ways of disposing of growing amounts of solid waste remains crucial. Just last month, mayors from across Latin America met in São Paulo to discuss ways that they could cooperate and exchange expertise to improve waste management in their cities.

The meeting, the first of its kind, was organized by both the city and state of São Paulo with support from the Brazilian Cooperation Agency and the United Nations Development Programme (UNDP). It was one of several preparatory events designed to set the stage for UNCED.

Even before the meeting was planned, one city that was quick to move on its own to improve its sanitation systems and protect its environment was Quito, Ecuador's historic capital. Nestled high in the Andes, the sprawling city, renowned for its splendid churches and cultural monuments, is experiencing a rapid population growth of 4.5 per cent annually. Increasing at a more alarming rate, city officials say, is its volume of solid waste, which is now up to about 1,000 tonnes per day. Quito's archaic landfills, unsafe and improperly located, and its aging fleet of sanitation trucks, have made the task of safely disposing of this waste even more daunting.

"It is bad here," says Ramon Viteri, special adviser to Quito's mayor on international cooperation, "but not so bad as in some other Latin American cities, like Bogota."

One of the biggest obstacles to improving solid waste management in Quito, says Mr. Viteri, is the city's two main landfills, which were haphazardly constructed in what are now growing residential areas. "They are surrounded by communities where children play and have had bad effects on health and environment in the neighbourhoods," he says. "They give us several headaches."

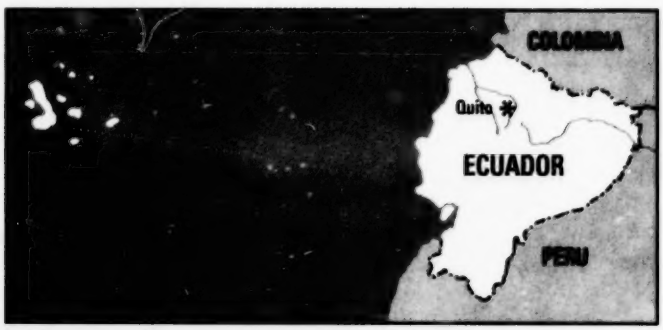
Pressed to come up with a solution or face a solid waste crisis of immense proportions, Quito officials designed a new municipal project that included creating a modern landfill and upgrading its fleet of sanitation trucks. Formulated with UNDP assistance as part of a broader programme to improve community development and public policies in Quito, the project attracted the support of a US$4.2 million World Bank loan and is now under way.

"This is a very important initiative for our city," says Patricio Gomez, deputy director of Quito's Department of Solid Waste. "It will modernize our collection and disposal systems and will lead to a better environment."

The new dump, which will replace the two now being used, is being constructed some 40 kilometres north of Quito and will cover over 80 hectares. It will be ready for use in 1992, and will serve the city for at least 20-25 years.

Giving the landfill issue even greater urgency is the fact that organic components of the solid waste from the current dumps are contaminating Quito's two main rivers, the Machangara and the Monjas. City officials say that the contaminants are seeping down into the earth and mixing with groundwater that flows into the rivers. Local farmers rely heavily on these water sources for irrigation.

"The city is studying the possible health effects that might result from



Above: Patricio Gomez, deputy director of Quito's Department of Solid Waste.

Above left: Minadores, local garbage sorters, collecting trash at Zambiza landfill.

Photos by Sid Kane / UNDP

Left: A street sign in Quito reminds its citizens not to litter.

using water from these rivers for irrigation," Mr. Viteri says. "Sewage and industrial waste also plague the rivers but by stopping contamination from landfills we will eliminate a big part of the problem."

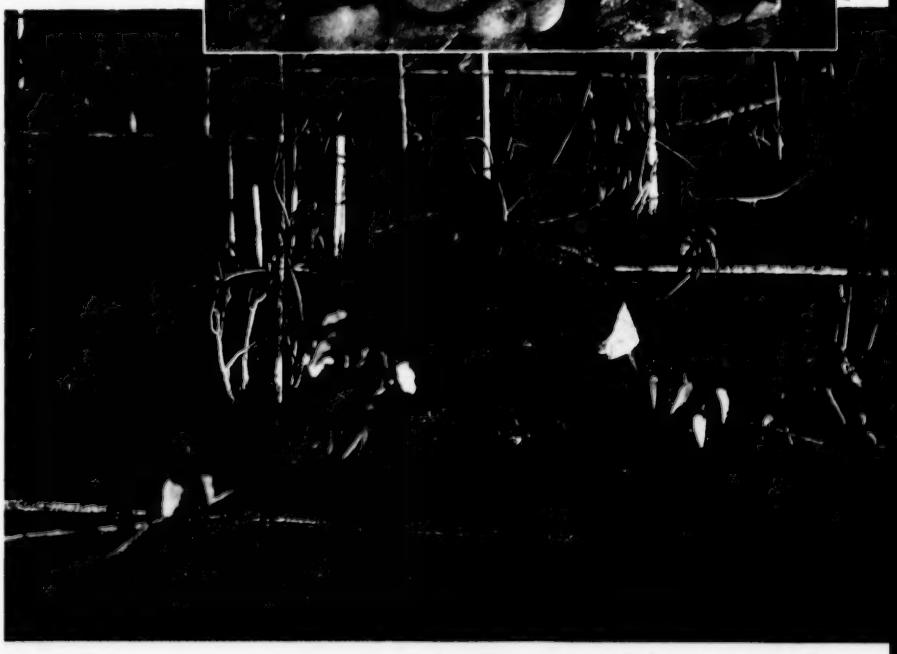
Along with the new dump, which will not pollute any rivers, Quito will also acquire a fleet of over 40 new collection trucks. The trucks now in use are subject to frequent breakdowns, and have a capacity of about half what the new ones will hold. The modern fleet is being financed in part by the World Bank loan and by Ecuador's National Bank for Public Institutions. "They will go a long way to making the whole system much more efficient," Mr. Viteri says. "We will use the old trucks for spare parts."

Additionally, new heavy equipment, including bulldozers for the landfill and solid waste compactors, are being acquired, and training in waste management techniques will help municipal workers improve their productivity. A plan is also under way to establish waste collection transfer points at key locations in Quito. Trash would first be brought to these points for processing before being transported to the landfill. All of this is to make sure that Quito's streets and rivers, in the face of increasing volumes of solid waste and a growing environmental awareness, stay healthy and clean.

"We are encouraged that this will help change the face of the city and make Quito a better place to live," Mr. Viteri says. "It is important both for today and for future generations." ■

Duckweed: A Lowly Plant Finds a Richer Role Cleansing Waste and Creating Protein

By Emma Robson



Photos by Paul Skilbeck - The Press Group

Top: Three species of duckweed are commonly found in Bangladesh.
Bottom: One farmer can manage only one-quarter of a hectare of duckweed, which requires labour intensive work.

Mirzapur, Bangladesh— A long-ignored common plant that will grow atop bodies of water virtually anywhere is being touted here as a revolutionary solution to malnutrition and poverty. It can also purify wastewater.

The exceptional properties of *Lemnaceae*, otherwise known as duckweed, have been well documented by scientists. When dried, its protein content—35 to 50 per cent—is similar to that of soya beans. Indeed, this fact has not escaped the entrepreneurial eye of Israeli farmers, who are growing the weed to sell to European health food stores as a salad. And since 1985, duckweed has been used as a means of purifying municipal wastewater in the US.

But now, for the first time in a developing country, *Lemnaceae* is being tested as a crop with a broader mission: to treat wastewater, to fatten fish, and as a cash crop.

Duckweed can survive anywhere but on ice caps or in deserts.

Its presence in the Americas, Europe and Asia suggests that it has existed for millennia, since the time when the world's continents were linked. At temperatures of between 15° C and 30° C, it can grow prolifically, doubling its wet weight within two to four days. In a given area, its yield can be 10 times that of soya beans. And all it takes to multiply is water rich in nitrogen, phosphorus and potassium—nutrients found in water polluted by human and animal waste or agricultural run-off. Its potential in Bangladesh, half of which is covered with fecally contaminated water for half the year, is enormous.

But to be truly useful, the plant's growth must be carefully controlled. In the wild the plants die and decompose, returning the nutrients to the water in

decomposing before serving any useful economic purpose.

Two-and-a-half years into tests of its different applications here, the plant has confirmed its miraculous potential. "It is a fabulous feed for fish," says Mohammad Ikramullah, chairman of Prism Bangladesh, the local branch of The Prism Group, a non-profit organization headquartered in the US. Prism Bangladesh is conducting the experiment, which it calls *shobuj shona*, Bengali for "green gold." Says Mr. Ikramullah: "For treating wastewater it is fantastic and for farmers it's obscenely profitable."

Prism Bangladesh is raising three species of *Lemnaceae* in ponds owned by the Bengali non-profit organization Kumudini Welfare Trust at its headquarters here, a two-and-a-half hour drive north-west of Dhaka, the capital. One aim is to set up farming systems for duckweed to be used throughout Bangladesh.

Farmers working under the experiment are achieving an average of one tonne of *Lemnaceae* per hectare per day, which The Prism Group estimates will net more than US$2,000 a year. "When you consider that the average annual income of a Bengali farmer is $100," says Mr. Ikramullah, "that's a fantastic amount."

Duckweed has a strong potential market here because it is a very cheap and high quality animal feed. The weed now retails at $27 a tonne, which is one-twentieth the price of the same weight of fishmeal, one-seventh of the price of oil cakes, and less than one-third of the cost of bran—other common types of animal feed. Fed to fish, it can triple average yields. Experiments conducted by The Prism Group in Peru have shown it also makes a valuable protein component of chicken feed when dried.

While basic training is required for duckweed production, no special skills or tools are necessary. It is a labour-intensive activity, which suits a country like Bangladesh where family sizes average six to nine people. Farmers have to first prepare their ponds. In low-lying areas of Bangladesh, this entails building up the pond banks to protect the crop from floods. Next, the farmers must have a source of growth nutrients for duckweed. Where domestic wastewater is available, the effluent of 100 people is estimated to be sufficient to fertilize a plot measuring one-quarter of a hectare, which is a manageable size for one farmer. The farmers must channel the polluted water into the ponds, then divide the ponds into production cells by floating bamboo or plastic "booms." The booms prevent the wind from sweeping the crop against the banks of the pond. Duckweed, a light, tiny green leaf-like frond with a rudimentary root, grows best when evenly dispersed. Once it is spread over the water, harvesting can begin within a matter of hours.

Using a butterfly net, farmers working on the experiment spend an average of three hours a day harvesting the duckweed from the banks. By observation alone, they learn how to leave a constant plant cover of around 600 to 800 grams per square metre, which is the ideal standing density for growth. In addition, they tend other crops such as sugar cane, taro, lentils and bananas around the plots, which act as wind and temperature buffers to keep the water temperature as close as possible to an ideal of 20° C.

In one series of ponds, the crop is grown by adding commercial fertilizers, which works out at a cost of $0.50 a day to fertilize one hectare. Other ponds are fertilized with human waste discharged by the Trust's headquarters, nursing school and hospital. Mr. Ikramullah says that besides costing more, he believes the ponds fertilized with commercial nutrients produce an inferior crop. In addition, he says, the ponds fertilized with human wastes are easier to manage because no nutrition management is required.

If the potential earnings of farming duckweed are impressive, those of raising fish on duckweed are astounding. In freshwater ponds in the Trust's grounds, Prism Bangladesh is raising different species of carp together—mirror, silver and grass carp, rohu and mrigal—by periodically adding fresh duckweed to feed "troughs" that float on the water. Fed exclusively on duckweed, the carp grow to reach between one and four kilograms each. "We have been able to sustain annual production of over 10 tonnes of carp per hectare without any mechanical aid and without any change of water," says Mr. Ikramullah. This compares with average fish yields in Bangladesh of only less than 400 kilos per hectare per year.

Raised together, the carp thrive on the duckweed, fattening to up to four kilos apiece. Some species feed on the duckweed directly, others on the fish excreta, to yield an average of 10 tonnes of fish per hectare per year. The Prism Group calculates that at an average price of $2 per kilo, such yields would bring in an average profit of $16,000 per hectare. This figure is net of the salaries of three farmers.

Prism scientists attribute the bumper carp harvests to the fact that, contrary to the traditional indirect way of feeding carp, the duckweed is eaten immediately and directly by the fish and therefore does not compete with them for oxygen in the water. Carp are usually raised by adding fertilizers or human waste to water to create algae and other plankton for the fish to eat. As algae grow, they consume oxygen. But they also consume oxygen at night, or when they die and decompose, which limits the fish's growth in the pond unless it is aerated artificially.

Results from the third part of the duckweed experiment—wastewater treatment—have been no less encouraging. Sewage from the Kumudini Welfare Trust complex is channelled into a narrow, winding channel built on a natural incline to facilitate flow. Duckweed, stabilized by booms, is harvested from the canal banks. After 20 days in the system, the wastewater

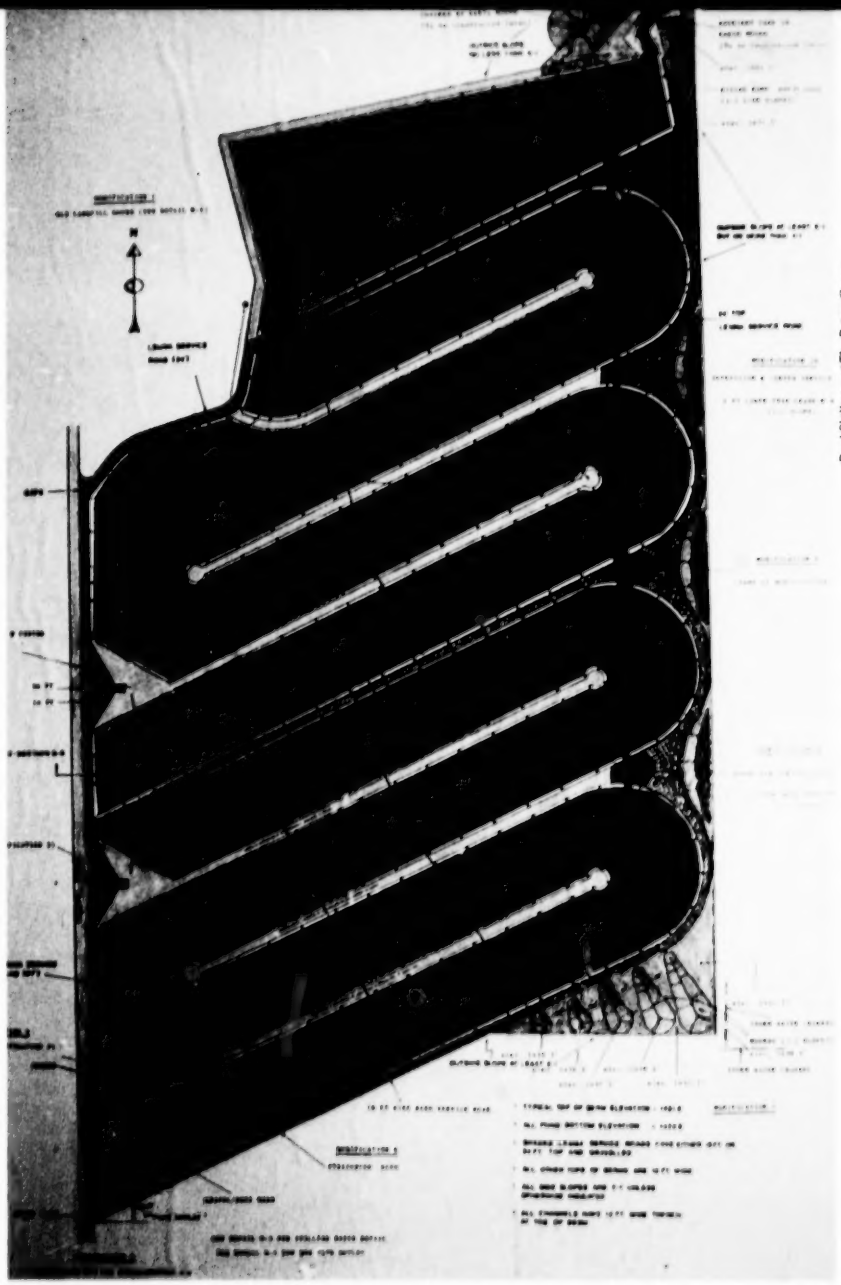
comes out crystal clear. Its phosphorus and nitrogen content—standard indicators of purity—are less than 0.5 milligrams per litre.

"It's purer than the purest surface water," says Mr. Ikramullah.

The concept of purifying wastewater in ponds through plant photosynthesis is not new. Water hyacinth has been used, with mixed results, as a purifying agent in wastewater lagoons. In multiplying, the plant takes up the undesirable excess nutrients, and gives out oxygen which restores water purity. But while water hyacinth is effective in stripping out nutrients, it is more sensitive to cool weather and its biomass is not as valuable. It can be used as compost, or as a component of animal feed, but its high fibre and low protein content make it of little commercial value. "It's like comparing copper and gold," says Tim Journey, a Prism Group associate who spent years in Bangladesh developing a new handpump on behalf of a water and sanitation programme the United Nations Development Programme (UNDP) runs jointly with the World Bank.

Having established the value of three functions of duckweed, the Prism Group now plans to take the farming technology to 10 villages in central Bangladesh. With a grant of $1.3 million from the UN Capital Development Fund, it plans to set up 15 production units in two years, and teach more than 400 peasants to become duckweed and fish farmers.

After that, Mr. Ikramullah expects to see a duckweed revolution in Bangladesh, where duckweed already proliferates thanks to the presence of organic waste from agriculture and human sources. The plant grows on the derelict ponds that surround almost every Bangladeshi village, where they add to the country's disease burden, but nothing to the local economy. A study by the Overseas Development Administration of the UK estimates there are around 500,000 hectares of derelict wastewater ponds throughout the country.



Paul Skillicorn / The Prism Group

Plan of the duckweed based wastewater treatment system in Bangladesh.

Now that average landholdings have dwindled to minute plots incapable of sustaining a family, and nearly 70 per cent of the rural population is landless, these ponds could turn out to be a valuable asset. One hectare of duckweed is worth 10 times a hectare of rice grown under the best local conditions. "As soon as families see that their wastes have value, they will take pains to concentrate fecal matter and appoint farmers to start production," says Mr. Ikramullah. "It's a practice that will catch on very fast." Already, several farmers in the Mirzapur area have begun growing duckweed. "I'm being besieged with requests for help and I

don't have enough people to transfer the technology," says Mr. Ikramullah.

The potential earnings of duckweed should motivate groups of families, who own their surrounding ponds, to deposit their wastes in simple waste-water treatment systems too. Little more than three per cent of the country's population has latrines that dispose adequately of human waste. As a result, most waste finds its way into bodies of surface water. "About 28,000 tonnes of human waste are disposed every day in the public domain in this country," says Philip Wan, who heads UNICEF's water and sanitation activities in Bangladesh. "This is a major environmental threat."

Lack of adequate sanitation partly explains why in Bangladesh diarrhoea is a major cause of death in both children and adults, despite the fact that nearly 80 per cent of the population has access to safe drinking water. "These open ponds are a focal point in Bengali daily life," says Mr. Ikramullah. "They wash their clothes in them, bathe in them, perform their ritual ablutions in them. So if we do not treat this surface water, all the safe water in the world will make little difference to the health of the people."

Besides lessening the country's disease burden, duckweed could improve the average peasant diet, whose quality has diminished during the population boom of the last 30 years as lentils have replaced fish as the main source of protein. "Fish, and especially carp, used to be the national food," says Joya Pati, managing director of the Kumudini Welfare Trust, which is Bangladesh's largest non-profit organization. "It was becoming so scarce that I was fearing the day we'd be limited to seeing it in a museum." Ms. Pati says that poverty has prevented aquaculture from being practised widely in

Duckweed is added to this winding treatment pond, which purifies water in 28 days.

Lemna Report / UNDP

Mohammad Ikramullah, chairman of Prism Bangladesh, with fish raised on duckweed.

Bangladesh, since to grow well, fish, like humans, require a high protein diet. "People are so poor their main concern is getting enough to eat themselves," says Ms. Pati. "Now, with duckweed, we can have enough fish to feed the people."

Perhaps in future years, *Lemnaceae* could overtake soya beans as the world's leading animal feed. Prism Bangladesh has recently started an experiment to dry the crop in a simple system using solar heat. The processing of duckweed as food is also a long-term plan of Lemna Corporation, a US company which holds a US patent on a technology it has developed to treat municipal wastewater using duckweed. In the medium-term, however, Lemna Corporation President Viet Ngo sees the weed's purification properties as its main asset, and one he is rapidly exploiting on an international basis.

"Lemna does the job as effectively as cumbersome, traditional wastewater treatment plants," says Mr. Ngo. "Only it is much cheaper." The company's systems offer savings of between 50 and 75 per cent, says Mr. Ngo, a naturalized American environmental engineer who emigrated from his native Viet Nam 21 years ago.

Such cost savings are helping the Lemna Corporation grow almost as rapidly as the plant itself. It built its first municipal wastewater treatment system in the US in 1985 and now has nine similar systems up and running. By 1992, Mr. Ngo expects to be working on more than 100 facilities worldwide. This year the closely-held company set up a joint venture with Gruppo Ferruzzi, the Italian agro-industrial giant, which has already won contracts from the Government of Egypt. The US company is also designing a system to treat the waste of Torreón, Mexico, with a population of two million. "As long as you have space, there are no limits to how much waste you can treat," says Mr. Ngo, who has also set his sights on purifying a large part of the waste of Mexico City's 20 million people.

Duckweed's ability to take up heavy metals is yet another interesting quality, although safe disposal of the heavily mineralized plant is a problem. Its apparent ability to thrive on brackish water has aroused considerable interest, but requires further research. "That one claim has staggering economic implications," says Mr. Journey, who is seeking funding for a thorough investigation. "Worldwide there are millions of hectares of waterlogged, saline land where agriculture is not possible."

Besides seeing vast new tracts of land harnessed to production, Mr. Journey's vision of the future embraces images of skyscrapers in Bangkok or Lima containing duckweed-based wastewater treatment and water recycling facilities, surrounded by parks carpeted with this aesthetically pleasing vibrant green weed.

Mr. Ikramullah, meanwhile, looks forward to a developing world that is self-sufficient in protein, with the strength it needs to build a richer future. "Duckweed is the future food for countries like Bangladesh," he says. ■

Canada's Deputy Health Minister Heads Collaborative Council

Margaret Catley-Carlson

Oslo, Norway—When Margaret Catley-Carlson was President of the Canadian International Development Agency (CIDA), she was taken to see a water-wheel supposedly designed for women in Tamale, northern Ghana. She tried her hand at the flywheel. "I discovered that if you had breasts, you could not work the wheel because it kept hitting your chest," she recalls.

The water-wheel was installed in an area where women had the primary responsibility for fetching water. "Ghanaian women had ample bosoms and could not use the water-wheel. That was my first introduction to women, water and wheels," she relates at the opening of the Water Supply and Sanitation Collaborative Council Global Forum. Mrs. Catley-Carlson, who is the Deputy Minister in Canada's Department of National Health and Welfare, is the Council's new chairperson.

Mrs. Catley-Carlson paid high tribute to former Council chairman, UNDP's Alexander Rotival, who retired on 30 September 1991. She also presided over the meeting which took place in Oslo, Norway from 18-20 September. It was organized by the Norwegian Agency for Development Cooperation (NORAD) in collaboration with the Swedish International Development Agency (SIDA), the Danish International Development Assistance (DANIDA) and the Finnish International Development Agency (FINNIDA) on behalf of the Collaborative Council.

Mrs. Catley-Carlson says she firmly believes in the integration of women in development not as a "moral obligation" but because it makes for better development. She says often women are "artificially excluded" from water organizations even though they are the ones making decisions, and using and maintaining water resources. "A man is ostensibly the head of the local organization," she says, "because that corresponds with the social imperatives." She adds that women need to pursue and take responsibility in these areas.

Mrs. Catley-Carlson said the Collaborative Council with its rich mixture of sector professionals, government representatives, country representatives, international organizations and non-governmental organizations, makes for an informed debate on the topic. "I am very honoured to be invited to take this post."

The Council, which was previously known as the Collaborative Council of External Support Agencies (ESAs) comprised 30 bilateral, multilateral and non-governmental organizations supporting water and sanitation programmes. At the New Delhi global consultation last September, an expanded Water Supply and Sanitation Collaborative Council was established incorporating professionals from both developed and developing countries and ESAs involved in water and sanitation.

The new chairperson says that there is a growing global awareness that involving developing countries and putting them in charge of water supply and sanitation in their respective lands was the most effective way to promote the sector. "The Council can pass all the resolutions and dicta in the world," says Mrs. Catley-Carlson, "but that will not necessarily change the priority that developing countries accord to water and sanitation. Water still has to compete with other sectors."

She adds that the Council can assist in making professionals in the sector more effective advocates for the cause. Mrs. Catley-Carlson served as president of CIDA from 1983 to 1989 prior to her ministerial position.

Outgoing chairman Alexander Rotival said he was pleased with the appointment of Mrs. Catley-Carlson to the Council, adding that he was "leaving the Council in extremely competent hands." ■

New Drugs for Worm Control

By Siddharth Dube

New York—Parasitic worms cause severe illness in millions of young children in low-income countries.

In eastern Africa and southeast Asia, thousands of children suffer from anaemia and physical and mental impairment caused by chronic hookworm infections. In western Africa, filarial worms blind young adults through repeated infections that start in infancy. The pork tapeworm cripples children in Colombia through larvae that form cysts in the eye, central nervous system or the heart. In India and across the African continent, Guinea worms cause unbearable agony when they emerge in flaming, open wounds on the lower limbs of children. Round, whip, and a host of other worms cause malnutrition and retard physical growth in children worldwide. Most infected children harbour several worm species.

Scientists and public health experts have, over the past century, employed an array of toxic drugs and lethal pesticides in their battle against these parasites.

They have had few successes. Worms are hardy creatures. They breed at great speed. Worse, they are transmitted to young children in innumerable ways—from excreta, contaminated water, food, and soil and by insects. Experts fear that control will be tragically delayed until the poorer countries can afford basic improvements in sanitation. Even many industrialized countries could only make these improvements as recently as the 1950s.

But public health experts are excited by a new generation of deworming drugs that they say are tailored to control worm infections in children. They met in August at a conference in Bellagio, Italy, organized by the Rockefeller Foundation and the United Nations Development Programme (UNDP). "The availability of broad spectrum, single-dose, low-toxicity drugs in the last 10 years seems a veritable miracle," says Dr. Kenneth Warren, director of the Maxwell Foundation, who attended the conference.

Writing in the September 14 issue of *The Lancet*, the medical journal, Dr. Warren notes that 19 of the 23 major worm infections can be controlled by just three drugs. Albendazole kills round, whip and hook worms. Ivermectin has made inroads into controlling river blindness in western Africa, and is effective against filarial worms, which cause elephantiasis and other severe health problems. The third drug, praziquantel, controls schistosome worms, a worldwide cause of debilitating urinary and rectal infections in children.

According to Dr.Warren, these drugs provide a rare opportunity to improve the health of school children. By the

Bernard Wolff / UNICEF

Worms are transmitted to young children through contaminated food and water.

end of this year, school age children will number over one billion and account for roughly 25 per cent of world population. Most live in poor countries. But despite having survived the risk of premature death from diarrhoea and other childhood killer-diseases, children over five are vulnerable to severe worm infections that retard physical and cognitive development.

Experts say that combinations of the new drugs should be tested to see if they can be mass distributed through schools in developing countries. They stress that school age children are old enough to be treated with these drugs and that they could check infection even if given at intervals of over a year. The drugs can possibly be combined to control infections by several worm species. In contrast to the global programme to immunize infants, which requires trained personnel to give injections and a refrigeration system for vaccines, deworming drugs can probably be given orally to children by school teachers and are not damaged by heat. "This is probably the simplest global human health campaign ever taken up," says Dr. Warren.

Dr. James Maguire, professor of tropical public health at the Harvard School of Public Health, said, "If you can administer these new drugs inexpensively, it would be logical to consider mass chemotherapy as they are non-toxic, quite safe and have proven benefits."

But despite the promise of the new deworming drugs, Dr. Maguire and other experts caution that it is too early to know to what extent the drugs can be used in the mass programmes suggested by Dr.Warren and some other participants at the Bellagio conference.

Praziquantel, the drug used to treat schistosome worms, has been successful largely because it is given only to infected people identified through diagnostic methods, say some experts. According to Dr. K.E. Mott, who directs the World Health Organization's programme to control schistosome worms, "It would be medically unjustified to give the drug to uninfected children, particularly because of the occasional severe or moderate side effects."

The plan to use ivermectin, which is effective against river blindness and filarial worms, may also encounter similar problems. Dr. Maguire at Harvard says that the drug may cause severe itching and eye problems in heavily infected people, which makes it necessary to have some kind of medical supervision.

The months ahead are likely to determine whether the new deworming drugs can be used in mass programmes for school children. Large operational research field trials are envisaged jointly by the Rockefeller Foundation, UNDP, UNICEF, and the World Health Organization. "I think it is good that there is a dialogue and that there are differences of opinion," says Dr. Maguire. "What it means to me is that there will be a careful evaluation of the proposed programmes and that something substantive will emerge from the discussion." ■

LOOKING AHEAD

Continued from page 2

about the absolute necessity to provide poor people with free water. However, studies have shown that the idea that water is a free commodity has been counter-productive in so far as providing water for the very poor. In many cases, these people are entrapped by water vendors who charge exorbitant prices for meeting their minimal requirements. This would not occur if there was better organization of the water and a charge levied for all water users. It is now becoming more acceptable that some element of cost-recovery is important if water is to become universally available.

In fact, over the past four or five years, water administrators have been talking about the privatization of water, ranging from charging all consumers for the water they use to collecting fees and decentralizing water supplies. These are possibilities that have to be examined, particularly in countries where governments are short on skilled and competent water and sanitation professionals. By bringing in the private sector, such expertise becomes available to planners. I regard this as an expansion of capacity building.

However, it must be understood that privatization of water supplies does not mean "hands off" as far as the government is concerned. The government must regulate and enforce standards. In Jamaica, for example, it is absolutely necessary to ensure that any effluent discharged into the sea meets standards that are acceptable. Otherwise, the country's tourist industry would disappear overnight.

One encouraging development is that there is now a greater awareness of water supply and sanitation issues, needs, problems and possibilities. Another improvement is the breakthrough in innovative, appropriate and low-cost technologies. Over the past 10 years, more than a billion people in developing countries have gained access to safe drinking water. Nearly 750 million have improved sanitation services.

The challenge for the future is to build on the available technologies, institutions and human resources toward expanding water supply and sanitation services to the millions of unserved people. ■

FROM THE WORLD HEALTH ORGANIZATION

SURFACE WATER DRAINAGE FOR LOW-INCOME COMMUNITIES
88 pages
Available in English and French; Spanish in preparation
ISBN 92 4 1544163 (Order No. 1150352)
Cost: Sw.fr.16 /US$14.40
In developing countries: Sw.fr.11.20
Available from WHO Distribution and Sales
1211 Geneva 27, Switzerland
or from:
WHO Publications Center
49 Sheridan Ave.
Albany, NY 12210, USA

Published by the World Health Organization in collaboration with the United Nations Environment Programme, this book teaches low-income communities how to design and construct simple, effective, low-cost drainage systems or rehabilitate existing ones. It contains practical as well as technical guidance, backed up by illustrations. Emphasis is on community participation at all stages, from planning through implementation, and particularly in maintaining the system once it is built.

FROM THE WORLD BANK

DUCKWEED AQUACULTURE: A NEW AQUATIC FARMING SYSTEM FOR DEVELOPING COUNTRIES
By William K. Journey, Paul Skillicorn and William Spira
68 pages
Available free from:
Gert van Santen,
Agriculture Division of the Technical Department of the Europe, Middle East, and North African Regional Office
The World Bank
1818 H Street, NW
Washington, DC 20433, USA

This publication describes current knowledge about farming tiny aquatic plants commonly known as "duckweeds," their potential as a protein-rich animal feedstuff and their value as a low-cost wastewater treatment technology. It was based on the results of an experimental programme in Mirzapur, Bangladesh from 1989 to mid-1991 where duckweed cultivation was established and fresh duckweed fed to carp and tilapia.

FROM UNICEF

PEOPLE, WATER AND SANITATION (WHAT THEY KNOW, BELIEVE AND DO IN RURAL INDIA)
40 pages
Available free from:
UNICEF House
73, Lodi Estate
New Delhi 110003, India
Tel: (91-11) 690401
Fax: (91-11) 619722

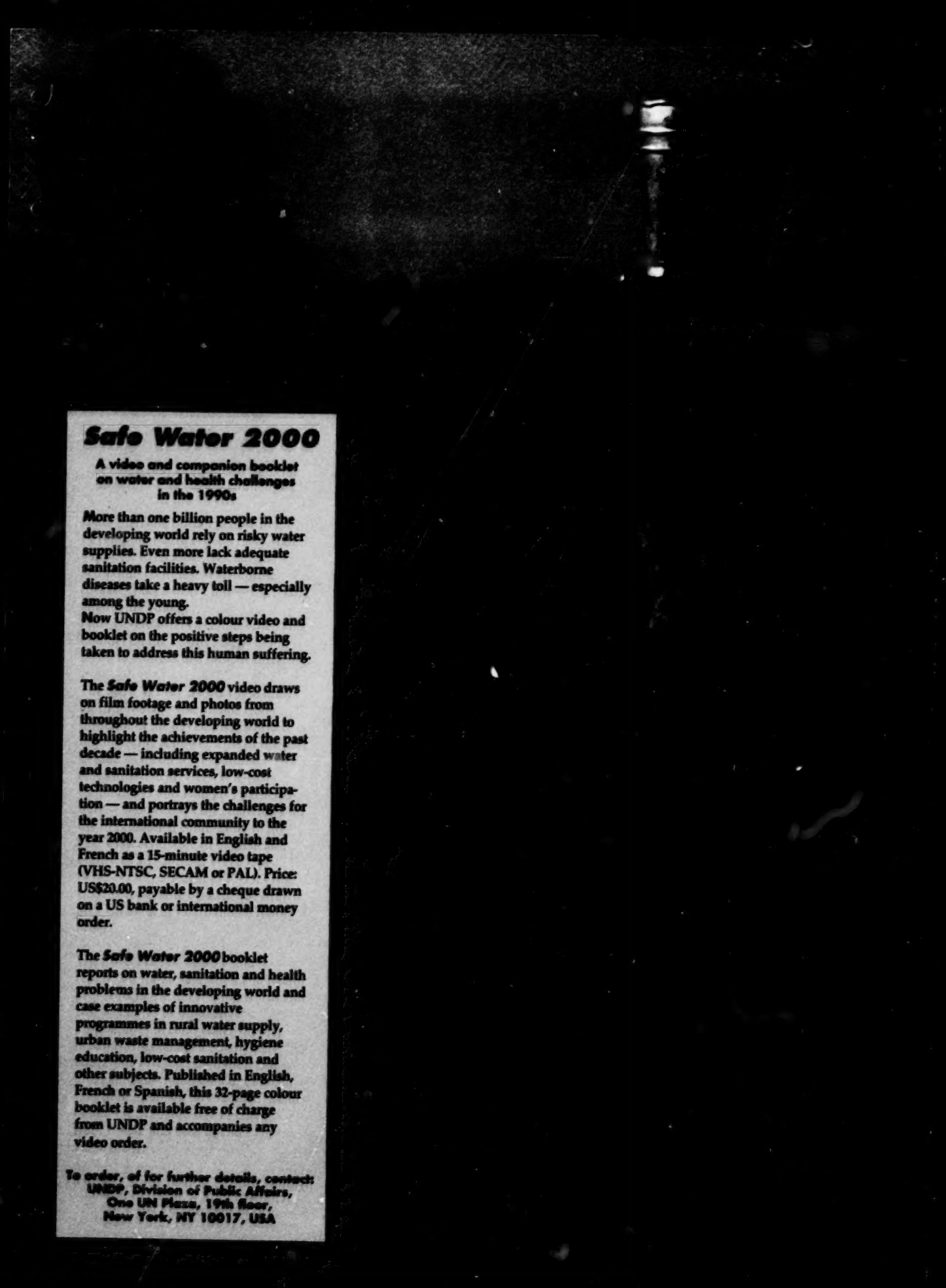
This booklet is based upon information contained in a report "Water, Environment and Sanitation: A Knowledge, Attitudes and Practices Study in Rural India, 1988-1989," which was prepared by the Indian Market Research Bureau (IMRB) for UNICEF. The study covered more than 7,900 individuals in villages of 22 districts in eight major states of India.

Questions like where people get water from, how they collect, use and store water, and their perceptions on cleanliness, personal hygiene and household hygiene are explored in this booklet.

FROM THE INTERNATIONAL DEVELOPMENT RESEARCH CENTRE

SOLAR-POWERED DESALINATION, A CASE STUDY FROM BOTSWANA
By R. Yates, T. Woto and J.T. Tlhage
56 pages
Price: Canadian $12 (free of charge in developing countries)
Available from:
International Development Research Centre (IDRC)
P.O. Box 8500
Ottawa, Ontario, Canada K1G 3H9
or from: UNIPUB
4611-F Assembly Drive
Lanajm, MD 20706-4391, USA

This book summarizes the results of a three-year field study carried out by the Solar Energy Section of the Rural Industries Innovation Centre (RIIC), a non-governmental organization based in Kanye, Botswana. The study was financed by IDRC and focused on the technical performance of various small-scale desalinators and their suitability to remote area dwellers. Several small-scale desalinators tested were found to be effective and easy to manage by rural people.



Safe Water 2000

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